

Title: Constructing Equations with Variables – Copycat

Brief Overview:

Students will explore equal relationships using pattern blocks. They will gain experience using the appropriate terms for several geometric shapes and practice using the symbols $<$, $>$, and $=$. Upon completing this unit, students will be able to describe equal relationships by writing equations and find the missing addends in an equation.

NCTM Content Standard/National Science Education Standard:

Students should be able to:

Numbers and Operation

- Understand numbers, ways of representing numbers, relationships among numbers, and number systems.

Algebra

- Understand patterns, relationships, and functions.
- Represent and analyze mathematical situations and structures using algebraic symbols

Geometry and Spatial Sense

- Use visualization, spatial reasoning, and geometric modeling to solve problems.

Grade/Level:

Grades 2-3

Duration/Length:

3 days (30-45 min)

Student Outcomes:

Students will be able to:

- Identify geometric shapes
- Represent relationships using appropriate relational symbols ($<$, $>$, $=$)
- Write a number sentence (equation)
- Find the missing number(s) in an equation

Materials and Resources:

- Pattern blocks (remove orange squares and tan parallelograms) for students
- Overhead pattern blocks for teacher
- Pattern block cut-outs (TR6 - copy and cut out shapes ahead of time)
- Overhead projector
- Teacher Resource (TR) pages 1-6 and Student Resource (SR) pages 1-11

- Toothpicks
- Snap Cubes
- Balance Mat (SR7)

Development/Procedures:

Lesson 1

Preassessment

- Prompt students to look around the classroom and identify familiar shapes.
- Display and name the hexagon, trapezoid, and rhombus. Ask students to name familiar objects that have these shapes (Correct students if they think a stop sign is a hexagon.)
- Distribute Match It Up (SR 9)

Launch

- Grade 2 Option – Give students SR1 worksheet to color geometric shapes.
- Distribute pattern blocks and 2 toothpicks, straws, popsicle sticks, or similar items that can be used to make the $<$, $>$, and $=$ symbols.
- Display the TR1 transparency. Show one pair of shapes at a time. Have students recreate the shapes at their desks and compare the sizes by inserting the symbol $<$, $>$, or $=$ between the shapes.
- Make sure students know that the number of pattern blocks does not always effect the size of the total shape.

Teacher Facilitation –

- Define the term congruent (two objects that are the same size and same shape).
- Demonstrate how two triangles form a rhombus. Prompt students to find a way to check that the shapes are congruent.
- Distribute SR2. Instruct students to use blocks to cover the trapezoid and then check that their designs are congruent to the trapezoid. Allow students to describe their designs while you create them on the overhead. If any designs are greater than or less than the original trapezoid, have students explain how they can tell they are not equal. Repeat for the other shapes on SR2.
- Let students compare their patterns for the last shape with their group or partner. Initiate class discussion to find which group had the most different patterns, the fewest pieces, and the most pieces. Point out that the shapes can still be congruent when different amounts of pattern blocks are used to form them.
- Hand out pattern block cut-outs (TR6). Instruct students to paste them on SR2 to show the congruent shapes they created.

- Collect SR2 to use in lesson 2.

Student Application

- Students choose a partner, partner A creates an original design using no more than 4 pattern blocks (2 pattern blocks for 2nd grade). Partner B has 2 minutes to copy the design using different pieces. Students then compare their designs to ensure that the pieces used are different and that the shapes are indeed congruent. Students then switch so Partner B creates an original design and Partner A “copies” it.

Embedded Assessment

- Journal entry: Describe how you and your partner were able to determine if your designs were congruent. Do you feel you were successful? Why or why not?

Reteaching/Extension –

- Extension – SR3 (Given several shape designs, put the shapes in order by size from least to greatest.)
- Reteach – SR4 (Given pairs of designs, identify the smaller of the two. Then identify how to make it congruent.)
- Reteach – SR10 (Are You a Copy Cat?)

Lesson 2

Preassessment

- Display designs from TR2 on the overhead. Have students use pattern blocks to build designs. Journal entry: Are these designs congruent? How do you know?

Launch

- Discuss journal responses as a class.

Teacher Facilitation

- Pass back SR2. Prompt students to name the individual pattern blocks used to create each design and how many of each were used. Have students list this information next to the designs.
- Write an equation for the first pair of shapes (1 blue rhombus = 1 green triangle + 1 green triangle) Remind students you can use the equal sign because they already checked that the designs are congruent.
- Initiate a discussion on how long it takes to write this information out. Demonstrate by writing an equation for the pair of shapes used in the pre-assessment. Then solicit student response on an easier way to write this. Sample questions – Do you know anyone who has a nickname? What do

each of the following abbreviations stand for – Dr., Mrs., Jr.? Have you ever written your initials instead of your entire name?

- Tell the students that instead of writing the whole name of the shape, you can use one letter(a variable) to stand for that shape. Prompt students to suggest variables for the individual pattern blocks. Once the class comes to a consensus, have students write the variables you chose next to the shape names they listed. (Since triangle and trapezoid both start with t, you may wish to guide students to use the first letter of the shape's color. If the children have difficulty visualizing the concept of variable representation, you may also need to label each shape in the design with the variable. For example, write y in all the hexagons, g in all the triangles, r in all the trapezoids, and b in all the rhombi.)
- Show students how to use the information you listed to write the equation $1b = 1g + 1g$ for the example.

Student Application

- Students write long equations for each pair of shapes on SR2 using the shape names and short equations using variables.

Embedded Assessment

- Match equations with pictures (TR3)

Reteaching/Extension

- Reteaching - Students practice writing equations for shape designs that are labeled (SR5).
- Extension – Students come up with their own variables for new shape designs (SR6).
- Extension – Students familiar with multiplication combine like terms and multiply. (i.e. $1b = 2g$)

Lesson 3A – Third Grade

Preassessment

- Students create shapes congruent to the blue rhombus, red trapezoid and yellow hexagon using only triangles to find out how many triangles it takes for each congruent shape. Discuss as a class.

Launch

- Tell students the triangle is worth 1. Ask them to find the worth of the other pattern blocks. On the overhead, label the shapes with their value (rhombus – 2, trapezoid – 3, hexagon – 6).

Teacher Facilitation

- On the overhead, create two congruent shapes. Write an equation for the shapes using variables for each block. Then substitute the value of the blocks to check that the sides are equal.

Student Application

- In groups of 4, students play a memory game called Sum It Up! Two people will form a team. The addition fact cards are cut out and placed face down on the table. (Cut cards from TR4 ahead of time.) Partners A each choose a card and decide if the sums are equal. If they have a match, they keep the cards and pick again. If the cards do not have equal sums, Partners B each pick a card. (Variations: a. This game can also be played with 2 people. b. For students who are having difficulty, cards can be played face up. Instead of competing, players take turns finding cards with equal sums.)

Embedded Assessment

- Teacher observes students as they play Sum It Up! To see if they are able to determine sums that are equivalent.

Reteaching/Extension

- Use Are You a Copy Cat? (SR 10) for reinforcement of congruency
- Reteaching - Students continue to create equations from congruent pattern designs that have the value of individual shapes labeled with their worth. Then they add to check.
- Extension – Students solve equations with one variable (sample equations $1 + c = 5 + 1$; $10 + x = 8 + 4$; $5 + m = 2 + 2 + 2$; $2 + 3 + 1 = 2 + d$; $20 + 5 + 5 = 10 + 10 + p$; $f + 4 = k + 6$; $9 + 1 + 1 = v + 6$)

Lesson 3B Grade 2 Sum It Up!

Preassessment

- On overhead projector or chart paper on board display the following equations:

$$1 + 3 = 2 + 2 ; \quad 5 + 6 = 7 + 4; \quad 1 + 3 = 3 + 1$$

- Tell students to indicate true or false for each equation with “thumbs up” for true and “thumbs down” for false.

Launch

- Refer back to the preassessment and have students explain each of their answers for the above equations.

- Teacher may need to prompt students with questions that ask the sum of one side of the equation and then the other side?
- What strategies did you use to arrive at your answers?

Teacher Facilitation

- Distribute 2 sets of snap cubes to each student and a balance mat. (SR 7)
- Ask students to use the snap cubes to find the sum of the first half of the equation. ($1 + 3$) Place on one side of the balance mat. Then add the other side of the equation. ($2 + 2$) Place it on the other side of the balance mat.
- Do both sides of the balance mat look the same? What do we call things that are the same in shape, size and quantity? (equal, congruent)
- Repeat process with remaining equations. Have students suggest additional equations that are equal and use different addends in the equations.

Student Application

- Use addition fact cards, which can be purchased or teacher-made on 3 x 5 index cards, with the equation side of card facing up.
- Each student will take a turn picking two fact cards. The two fact cards are considered a match when the equations on both cards are equal. Students should state how they are equal. i.e.: $1 + 3 = 4$ and $2 + 2 = 4$. Therefore, both problems are equal. The student has now earned this set of cards.
- If the cards selected are not equal and the student does not recognize that or can not explain why they are not, student will not earn that set of cards as a match. Student would be required to use the snap cubes and balance mat to show that the problems are equal.
- During student observations, notice if matches are equal. If not, have students use snap cards and the balance mat to check addition equations.
- The students will now complete Sum It Up! (SR 8)

Embedded Assessment

- Use teacher observation to assess student progress in mastering basic addition facts up to sums of 18 without regrouping. Use of addition cards may be used throughout the year for mastery.
- Student journal prompt. Describing how you know when things are equal. You may include a drawing.

Reteaching/Extension –

- Reteaching should include continued review and practice with concrete manipulatives and balance mat to show equal numbers.
- Practice with single digit addition problems and addition flash cards.
- Extension of this concept for students that are competent at these equations, leaving a blank for one of the addends. See SR 8
 $6 + 7 = 7 + \underline{\quad}$ or $6 + 7 = 8 + \underline{\quad}$

Summative Assessment:

Use SR11 as a summative assessment.

Authors:

Barbara Thompson
Cameron Elementary School
Fairfax County Public Schools

Jana L. Parker
William B. Powell Elementary School
District of Columbia Public Schools

Date _____ Name _____

Match It Up

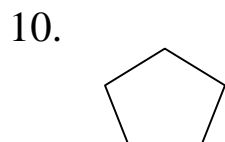
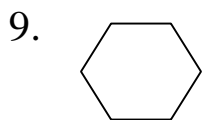
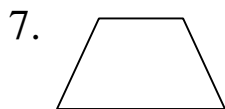
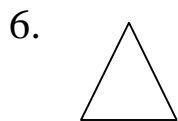
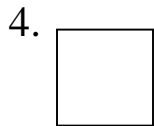
Directions: Look at the symbols and pictures in column A. Draw a line to the matching vocabulary word in column B.

Column A

1. =

2. +

3. -

Column B

a. Subtraction

b. Rectangle

c. Trapezoid

d. Rhombus

e. Hexagon

f. Pentagon

g. Triangle

h. Addition

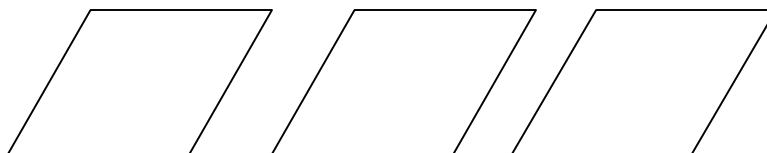
i. Equal

j. Square

Name: _____ Date: _____

Directions: Write the name of each shape. Then color the rhombus shapes blue, the trapezoids red, the triangles green, and the hexagons yellow.

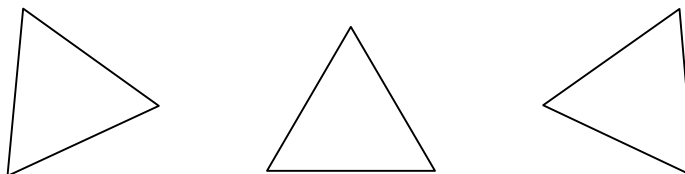
Rhombus



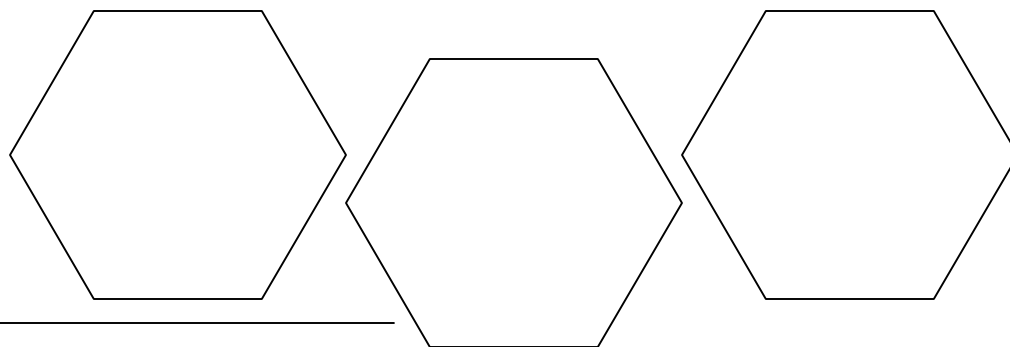
Trapezoid

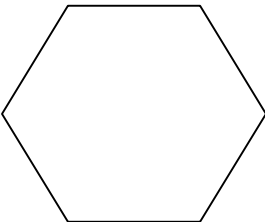
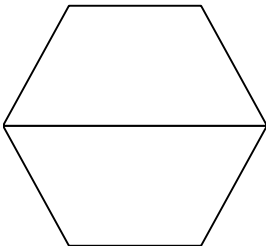
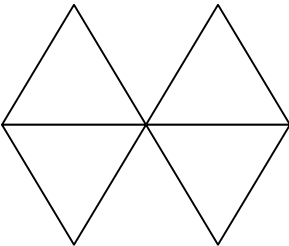
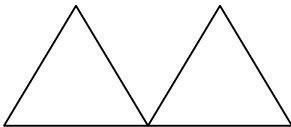
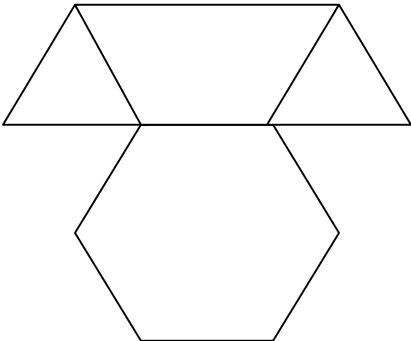
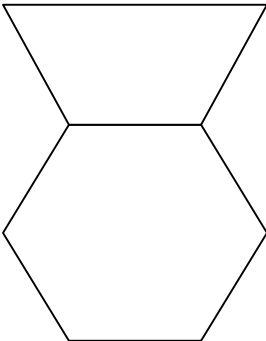
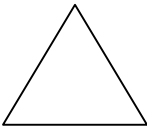
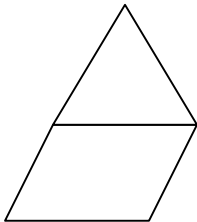


Triangle



Hexagon



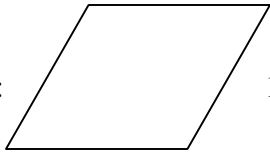


Name: _____

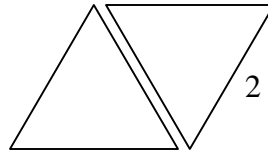
Date: _____

Directions: Use pattern blocks to cover the shapes below. You may not use the blocks that are shown. Then paste cut-outs of the pattern blocks you used to show your design.

Example:



1 blue rhombus



2 green triangles

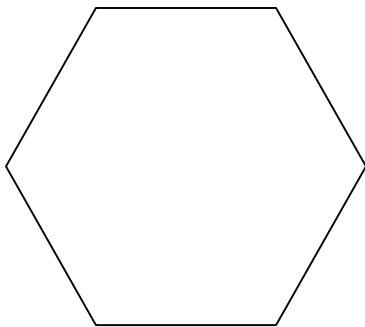
=
=

Cover:

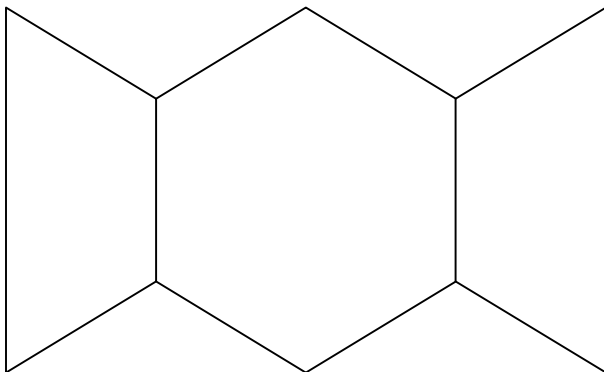


=
=

Paste:

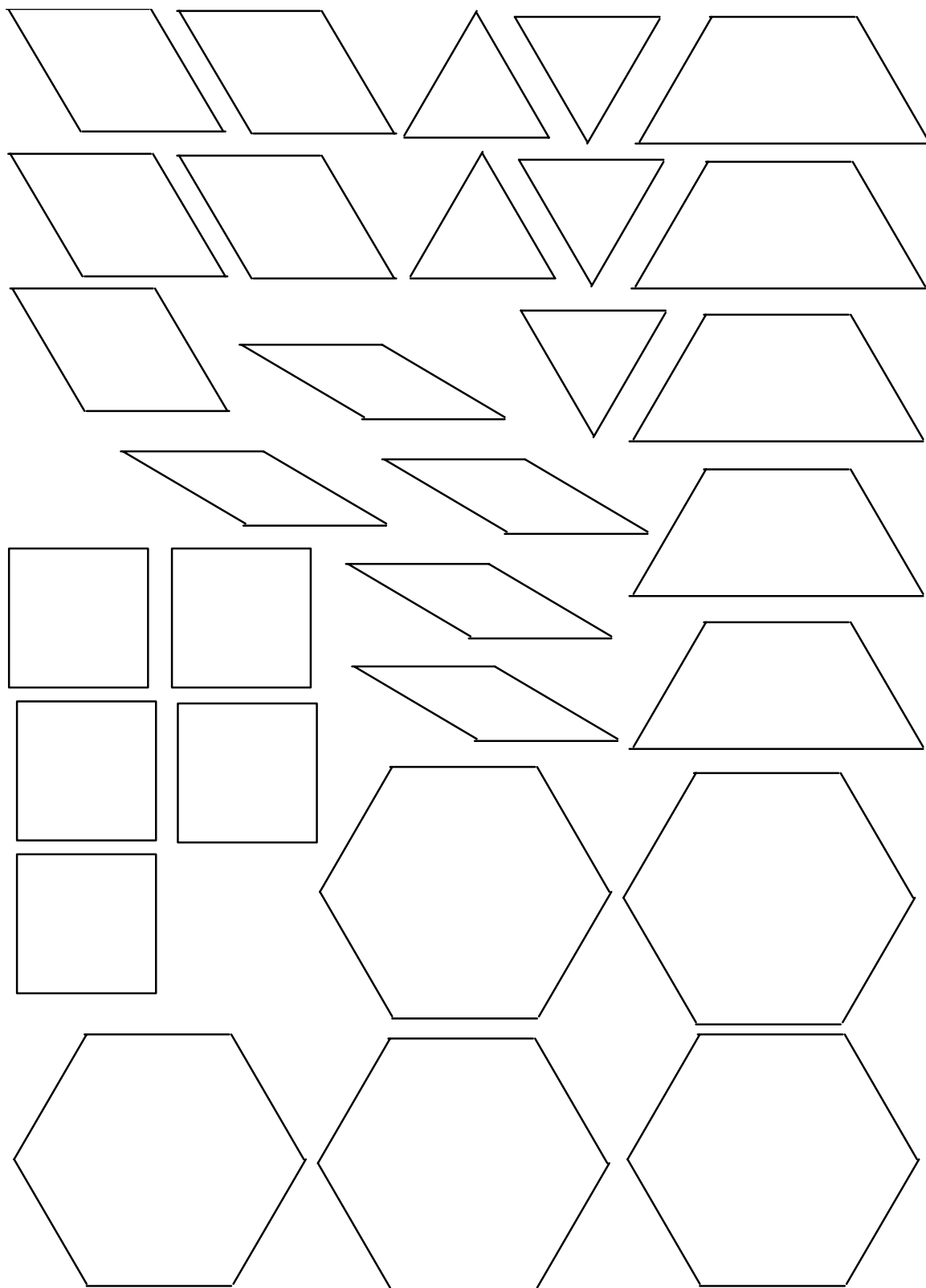


=
=

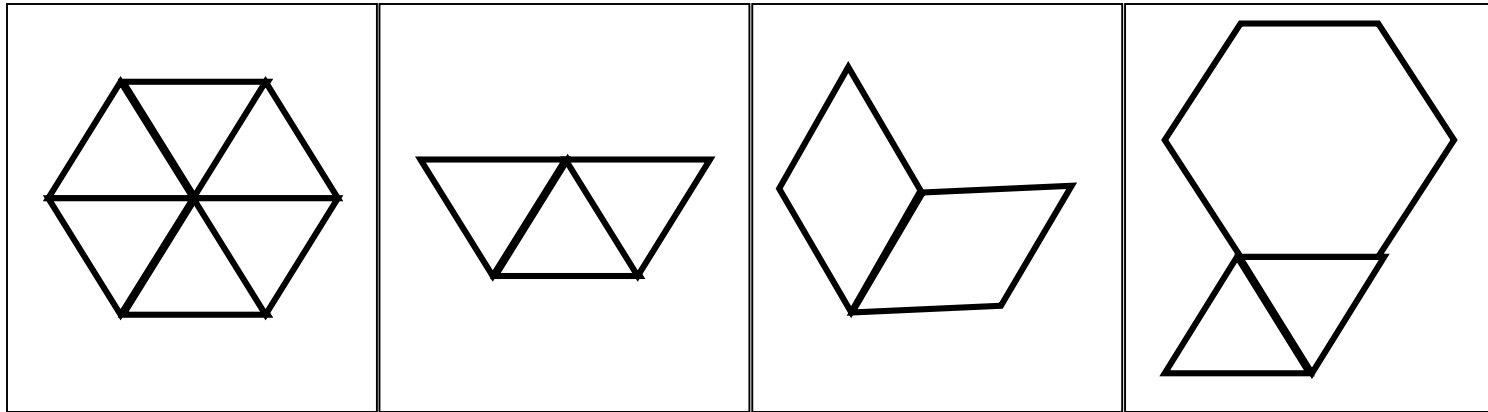


=
=

PATTERN BLOCKS



Directions: Cut out the following shapes. Paste them in order by size from least to greatest. Remember, the shape with the most pieces is not always the greatest in size.



Name: _____

Date: _____

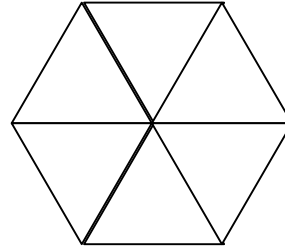
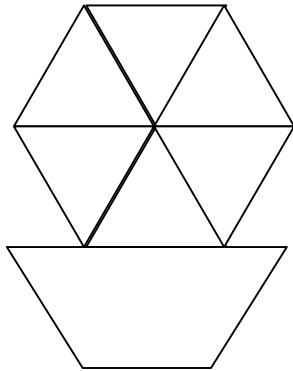
<

<

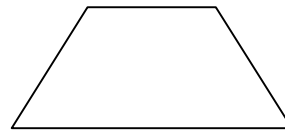
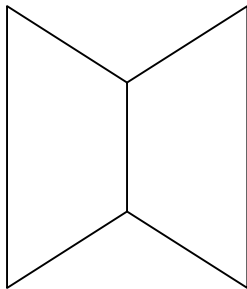
<

Name: _____ Date: _____

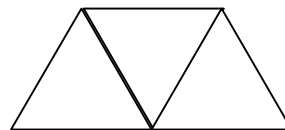
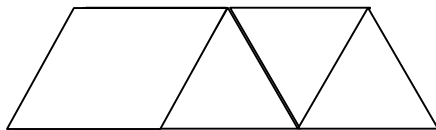
Directions: Look at the pairs of shapes. Circle the shape that is the smallest. Then tell what shapes are missing.



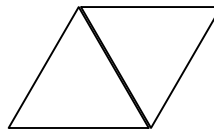
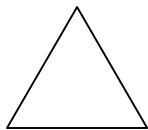
1.



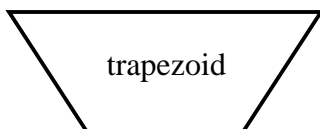
2.



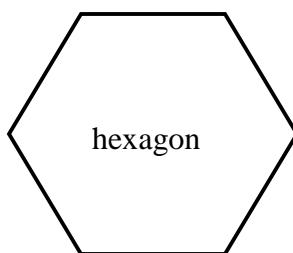
3.



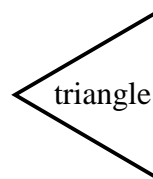
4.



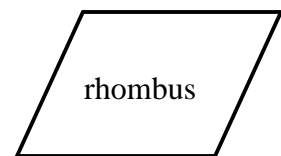
trapezoid



hexagon



triangle

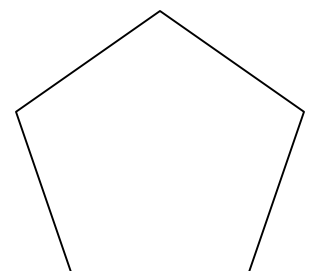
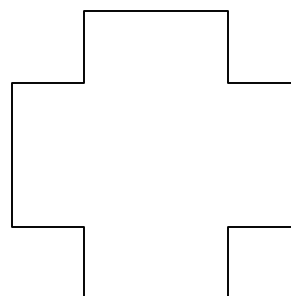
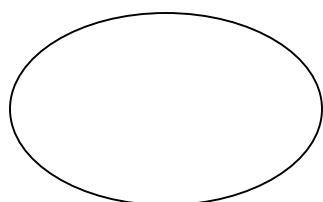
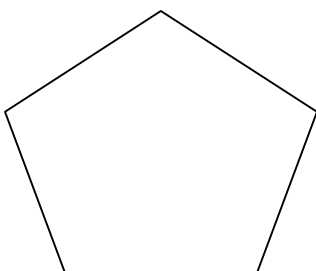
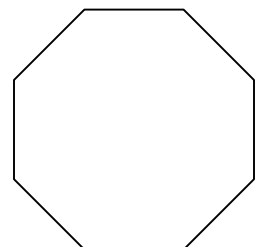
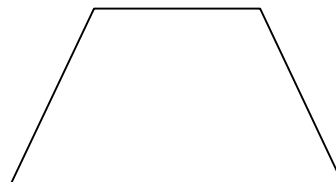
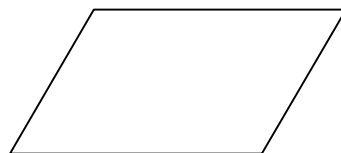
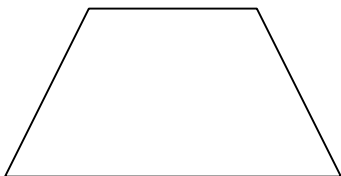
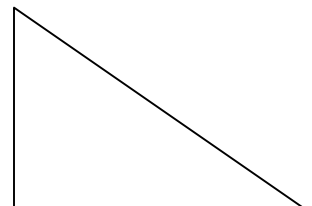
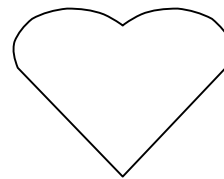
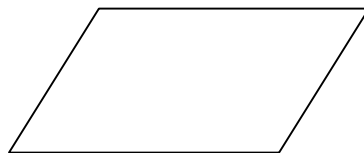
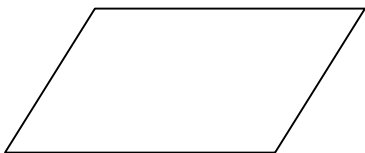
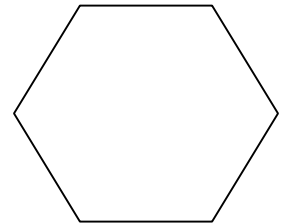
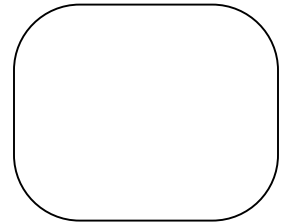
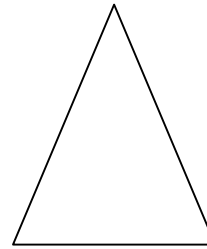
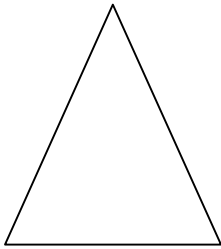


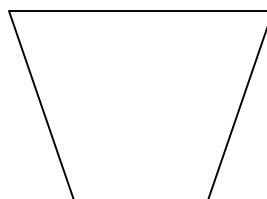
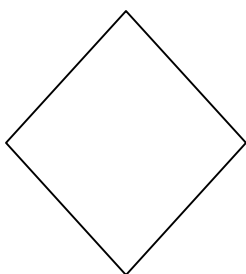
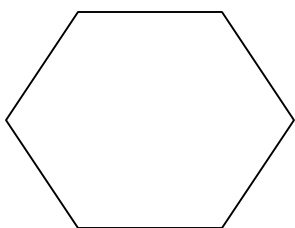
rhombus

Date _____ Name _____

Are You A Copy Cat?

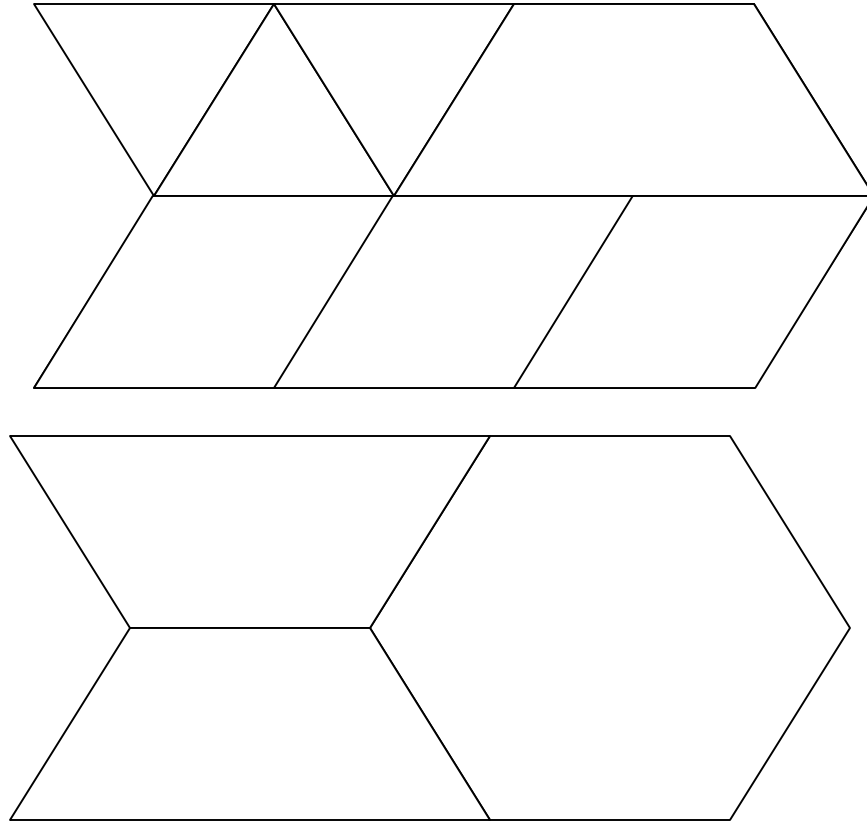
Directions: Use your crayons to color the matching shapes on each row.





Lesson 2 Pre-Assessment

Journal entry: Are these shapes congruent? How do you know?



Long equation

1 green triangle + 1 green triangle + 1 green triangle + 1 red trapezoid + 1 blue rhombus +
1 blue rhombus + 1 blue rhombus = 1 red trapezoid + 1 red trapezoid + 1 yellow hexagon

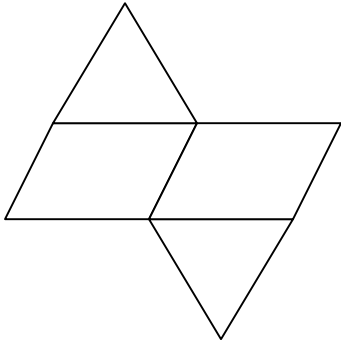
Match each shape with its number sentence. The following variables have been used.
Triangle – g, Trapezoid – r, Rhombus – b, Hexagon – y

1



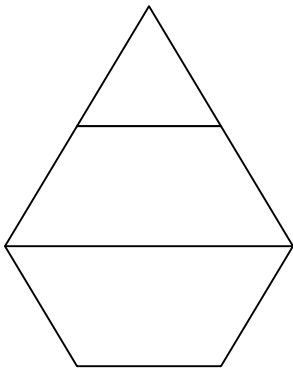
$$1y + 1r + 1g + 1g$$

2



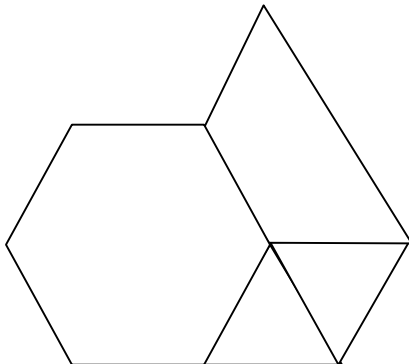
$$1g + 1r + 1r$$

3



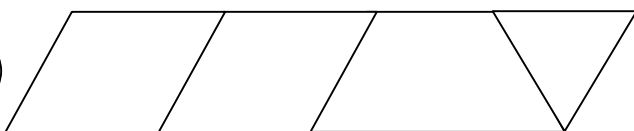
$$1g + 1b + 1b + 1g$$

4



$$1b + 1b + 1r + 1g$$

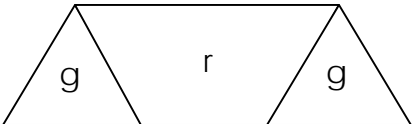
5

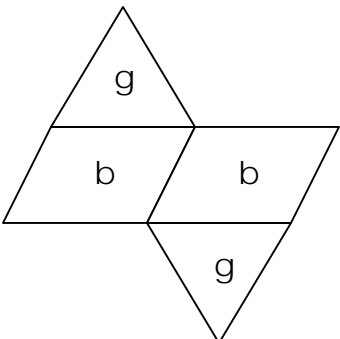


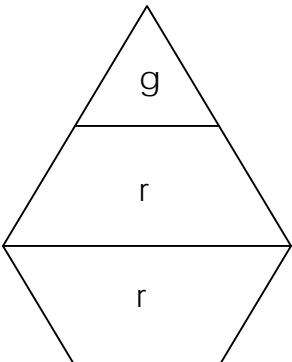
$$1g + 1r + 1g$$

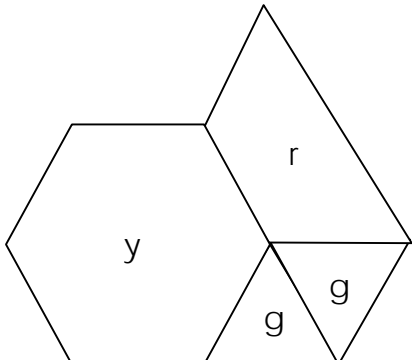
Name: _____ Date: _____


Directions - Use variables to write an addition sentence for each shape.
 Triangle – g, Trapezoid – r, Rhombus – b, Hexagon – y

①  = _____ + _____ + _____

②  = _____ + _____ + _____ + _____

③  = _____ + _____ + _____

④  = _____ + _____ + _____ + _____

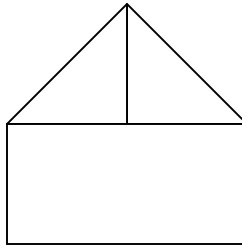
⑤  = _____ + _____ + _____ + _____

Name: _____

Date: _____

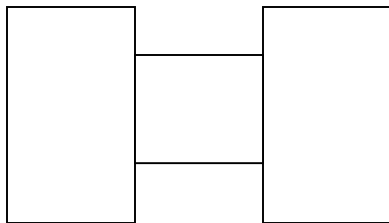
Directions – Use the shape names to write an addition sentence for each design.
Then give each shape a variable and use your variables to write a new addition sentence for each design.

Shape	Variable
Triangle	
Square	
Rectangle	



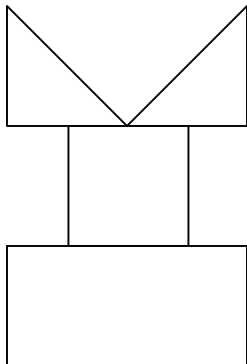
= 1triangle + 1 triangle + 1 rectangle

=



=

=



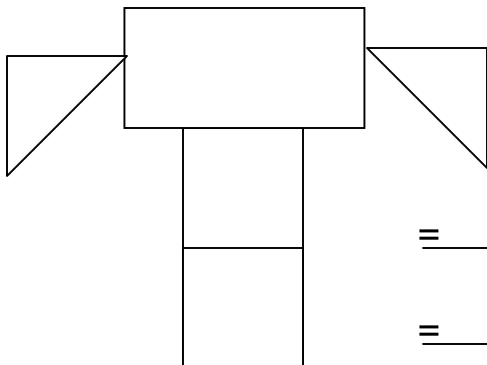
=

=



=

=



=

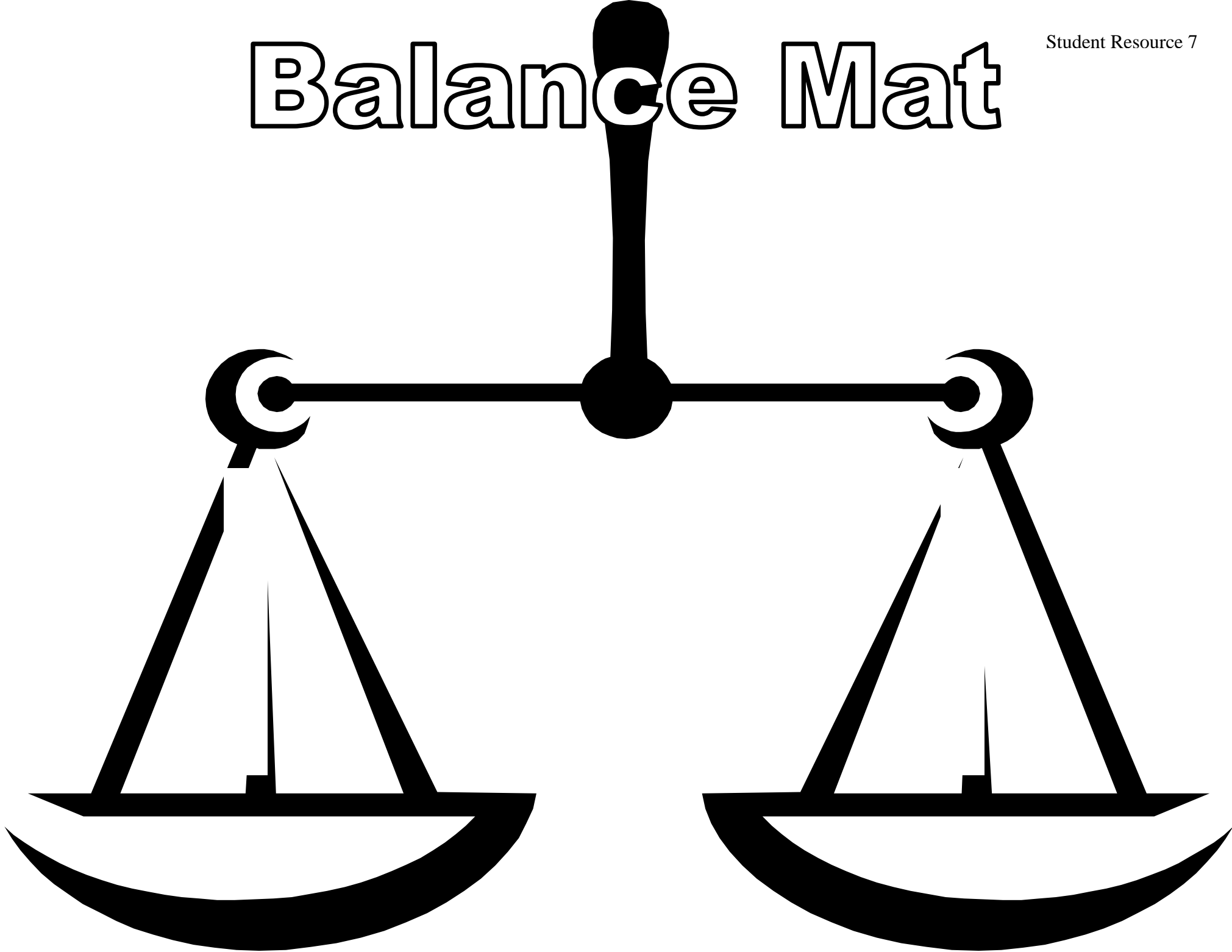
=

Teacher Resource 4 – Sum It Up! Cards

$2+3$	$2+2+1$	$4+3$
$5+2$	$6+3$	$8+1$
$3+3+4$	$5+5$	$6+4$
$7+3$	$3+3$	$5+1$
$4+4$	$3+5$	$6+5$
$7+4$	$5+5+1$	$2+8+1$
$6+6$	$9+4$	$7+7$
$8+6$	$9+6$	$10+5$

Balance Mat

Student Resource 7



Date _____ Name _____

Sum It Up!!

Directions: Read each math equation. Fill in the blank with the missing addend to complete the problem. **Hint:** equations on both sides of the = sign must be the same.

1. $2 + 1 = 1 + \underline{\hspace{2cm}}$

2. $3 + 2 = 2 + \underline{\hspace{2cm}}$

3. $5 + 2 = 3 + \underline{\hspace{2cm}}$

4. $\underline{\hspace{2cm}} + 4 = 4 + 4$

5. $\underline{\hspace{2cm}} + 5 = 5 + 6$

6. $\underline{\hspace{2cm}} + 7 = 7 + 2$

7. $9 + 3 = \underline{\hspace{2cm}} + 6$

8. $7 + 7 = \underline{\hspace{2cm}} + 8$

9. $5 + 4 = 9 + \underline{\hspace{2cm}}$

10. $3 + \underline{\hspace{2cm}} = 8 + 1$

11. $8 + \underline{\hspace{2cm}} = 9 + 8$

12. $7 + \underline{\hspace{2cm}} = 6 + 7$

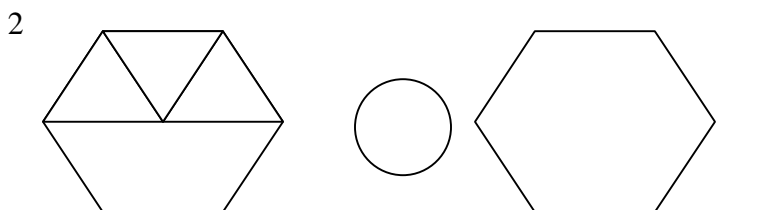
Summative Assessment

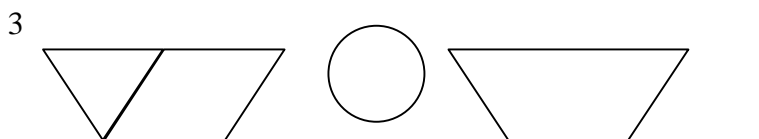
Name: _____

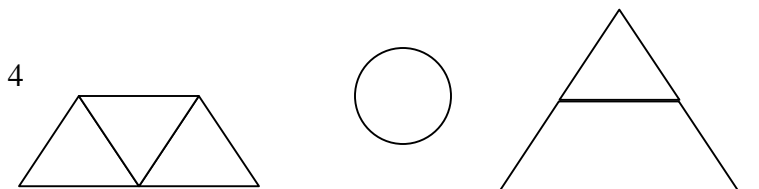
Date: _____

Use $<$, $>$, or $=$ to compare the size of the following shapes. Explain your answers. Make sure you use the names of the individual shapes in your explanation.









Circle the answer that makes the number sentence correct.

5. $5 + 10$ ☐ $5 + 5 + 5$

a. $<$ b. $>$ c. $=$

6. $4 + 2$ ☐ $6 + 2$

a. $<$ b. $>$ c. $=$

7. $7 + 1 + 3$ ☐ $8 + 0 + 2$

a. $<$ b. $>$ c. $=$

8. $10 + 2 = h + 10$

$h =$

a. 12

b. 2

c. 1

9. $6 + 7 + 1 = 3 + 3 + y$

$y =$

a. 8

b. 6

c. 7

1. $r + 0 = 4 + 4$

$r =$

a. 4

b. 0

c. 8

1. Addition: To join or put things together. The act or mathematical process of adding.
2. Angle: A corner or area near a corner.
3. Equal: Of the same measure, quantity, amount, or number as another.
4. Equation: A quantity added or subtracted in equating a process.
5. Hexagon: A plane polygon of six angles and six sides.
6. Parallel: Extending in the same direction, forming a line in the same direction but not meeting.
7. Parallelogram: A quadrilateral whose opposite sides are parallel.
8. Pentagon: A polygon having five sides and five angles.
9. Rectangle: A parallelogram of all angles is right angles. One with adjacent sides of unequal length.

10. Rhombus: An equilateral parallelogram.
11. Square: A parallelogram having four equal sides and four angles.
12. Subtraction: The mathematical in which one number or quantity is deducted from another.
13. Trapezoid: A quadrilateral having only two parallel sides.
14. Triangle: A usual polygon having three sides and three angles.